Space Weather Technical Forecast

Issued on Friday, 13 October 2023 at 01:44 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Ongoing Chance of M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity, as measured by GOES16 and 18 been at Moderate levels over the past 24 hours, with previous region AR3451 producing a peak M1.1 flare at 12/0458UTC. This was preceded by a long-period C9.7 flare from AR3460, which at the time was located south-centre disc. The flare from AR3460 does not appear to have been associated with a CME. There are currently seven sunspot regions on the visible disc. AR3460, AR3463 and AR3464 are all moderately magnetically complex, although the first two regions have decayed slightly in size and spot number through the period. AR3464 increased slightly in magnetic complexity, to become Dsi/beta-gamma, and was the only region to show an increase through the period. The remaining regions where generally smaller and magnetically simple.

There are numerous filaments on the Earth-facing disc at present, although none of the numerous CME's visible in available coronagraph imagery appear to be the result of a filament eruption. The majority of CME's appear to be from far sided sources, and unlikely to be Earth directed. However, a far sided event which started around 12/1000 UTC then spread to the Earth-facing side of the Sun, with an associated CME potentially Earth-directed. Analysis will be undertaken now that imagery has become available again.

Solar Wind / Geomagnetic Activity: Solar winds, as observed at L1 by ACE/DSCOVR, continue to show a slow regime, albeit with a weak Solar Sector Boundary Crossing (SSBC) observed at 11/1515UTC, whereupon the phi angle changed from negative (towards the Sun) to become positive (away from the Sun). It is remotely possible that indicated the awaited fast wind from CH58/-, however it was extremely weak if this was the case, with no change in solar wind speeds, and also temporary with the phi angle returning to negative values later in the evening. The solar wind speed was predominantly around 300 km/s, with the density below average in single figures ppcc. The IMF was mainly weak, but after a minor discontinuity associated with the SSBC the IMF increased to briefly touch moderate values at times through the evening, peaking at 9 nT. The north-south component was mostly neutral or positive, but did occasionally become weakly negative, reaching -2 nT.

The net effect of the above solar wind measures was Quiet geomagnetic activity throughout, with Kp at 0 or 1.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels, with no obvious minor response to any of the observed flare events of the period.

GOES16 high energy (greater than 2MeV) electron flux was at Background to Moderate levels, peaking around 264pfu at 12/1835 UTC. Associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. The observation at 13/0000 UTC was 5.48e6 integrated pfu.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: There is a continuing Chance of M-class flares through the four-day period.

Solar Wind / Geomagnetic Activity: The CME associated with the C6.6 flare of AR3460 on 08 Oct is now though to have missed Earth. At present no Earth directed CME's are expected. However, analysis will be undertaken on some CME's that are apparent in chronograph imagery, which has now returned.

The fast wind expected from CH58/- is now well overdue and unlikely to arrive. Late on day 4 (16th) a HSS from CH60/+ may arrive. Therefore geomagnetic activity is currently forecast to remain at predominantly Quiet levels (Kp 0-2), with a chance of isolated Unsettled (Kp 3) intervals until late day 4. Then activity may increase to become Unsettled to Active (Kp 3-4) with a chance of G1-G2 (Kp 5-6) conditions developing under the influence of a CIR ahead of the HSS from CH60.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux will most likely remain at Background levels.

High energy electron flux (greater than 2MeV) is forecast to continue at background to moderate levels, with a HSS from CH58 no longer expected to arrive. Therefore the associated 24-hour fluence is expected to remain well below the Active (1e8 integrated pfu) threshold.

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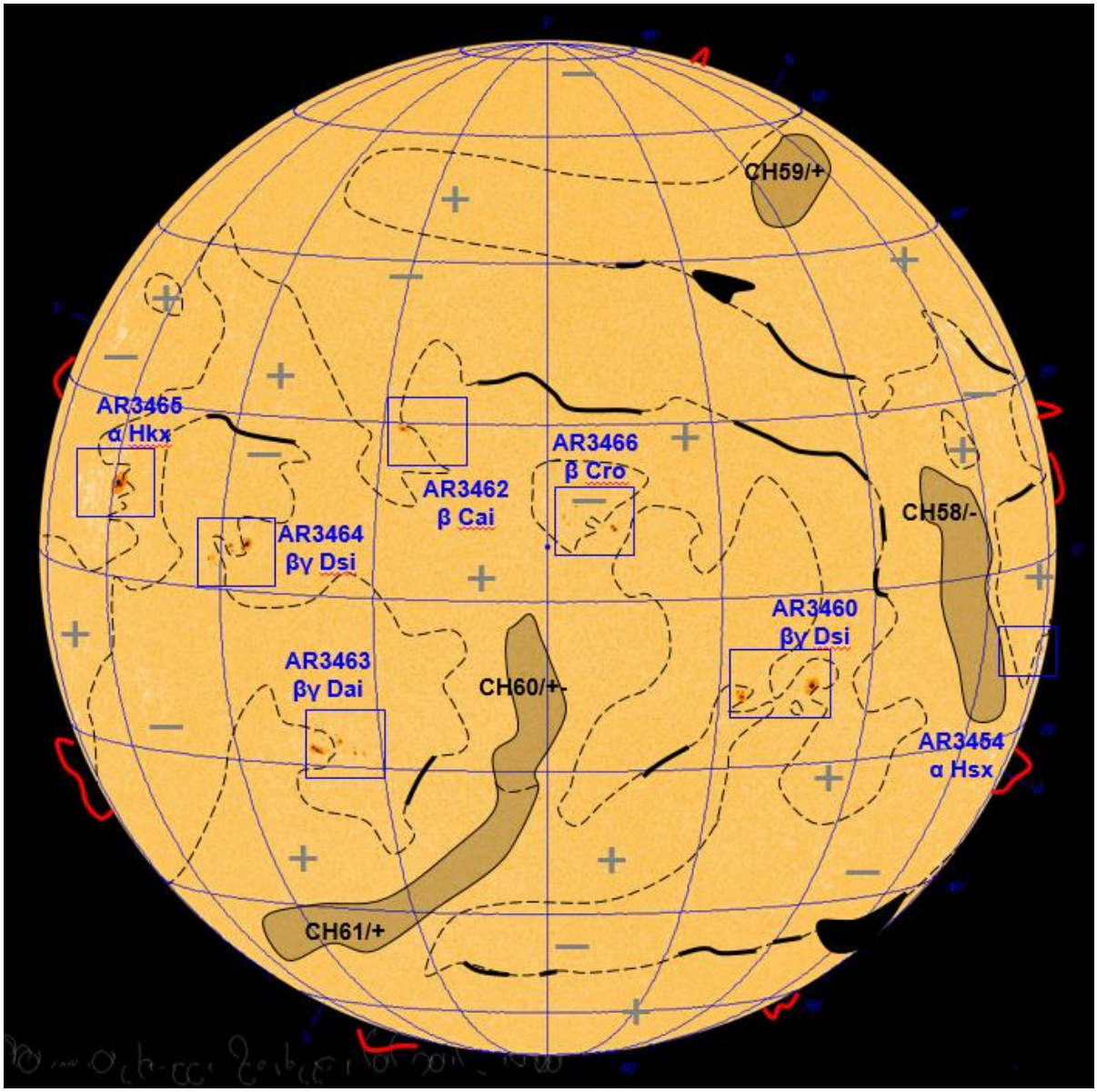
Figure 1. Solar Analysis Valid 12/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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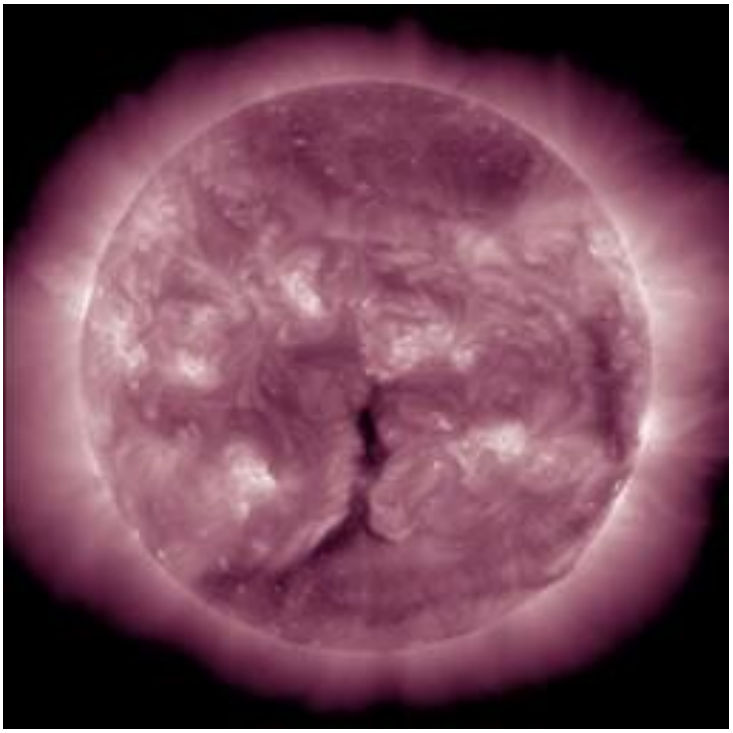
Geomagnetic Storms:

The CME associated with the C6.6 flare of AR3460 on 08 Oct is now though to have missed Earth. At present no Earth directed CME's are expected. However, analysis will be undertaken on some CME's that are apparent in chronograph imagery, which has now returned.
The fast wind expected from CH58/- is now well overdue and unlikely to arrive. Late on day 4 (16th) a HSS from CH60/+ may arrive, with wind speeds potentially increasing 450-500 km/s. This feature was smaller and further south on the previous rotation, and CME arrivals complicated the HSS signal. Therefore the use of persistence at this current time is not reliable.
Geomagnetic activity is currently forecast to remain at predominantly Quiet levels (Kp 0-2), with a chance of isolated Unsettled (Kp 3) intervals until late day 4. Then activity may increase to become Unsettled to Active (Kp 3-4) with a chance of G1-G2 (Kp 5-6) conditions developing under the potential arrival of a HSS from CH60, which is a positive coronal hole feature and so more likely to result in a geomagnetic response this close to the equinox.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Latest SDO/AIA 211 image showing coronal hole features.



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Radio Blackouts - X-Ray Flares:

There are currently seven sunspots on the visible disc. Imagery is now available again, and has shown that both AR3460 and AR3462 have decreased in spot number and size, and also AR3460 in magnetic complexity. AR3464 is the only region which has shown a slight increase in size and complexity, becoming a Dai/beta-gamma. All remaining regions are simple and either stable or in slight decay. Throughout the period new or returning regions are expected to rotate onto the visible disc, either maintaining the chance of significant flares or potentially increasing the chance as some of the far sided regions appear to be active. For now the chance of M-class flares is held constant throughout.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is most likely to persist at Background levels.
There remains a Slight Chance of S1/Minor Solar Radiation Storms throughout the period, should any suitable larger flares occur.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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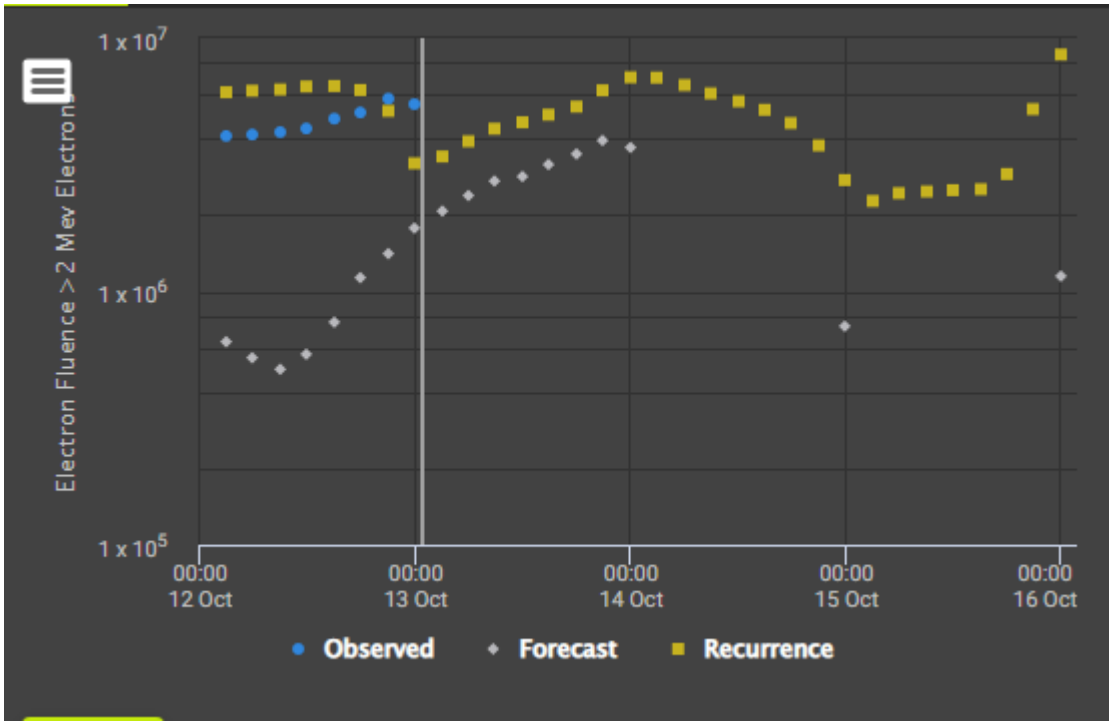
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is forecast to continue at background to moderate levels, with a HSS from CH58 no longer expected to arrive, and the next HSS from CH60 not expected until late in the period.

Therefore the associated 24-hour fluence is expected to remain well below the Active (1e8 integrated pfu) threshold, as indicated by the Met Office REFM model.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: Met Office REFM model.



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